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Types of Bonding

Electronegativity is a measure of the ability of an atom or molecule to attract electrons in a chemical bond. The type of bond between two atoms is related to the difference in electronegativity (ΔEN) of the two atoms that are bonded together:

$$\Delta EN = EN_2 - EN_1 \quad \text{where } E_2 \text{ is the element with higher electronegativity}$$
$$E_1 \text{ is the element with lower electronegativity}$$

The electronegativity of several common atoms is shown below.

F	4.0	C	2.5
O	3.5	S	2.5
Cl	3.0	H	2.1
N	3.0	Na	0.9
Br	2.8	K	0.8



For example, consider the bonding in ammonia, NH_3 .

The nitrogen atom has an electronegativity value of 3.0 while hydrogen has an electronegativity of 2.1. Therefore the bonded pair of electrons in any N-H bond spend more time near the nitrogen atom.

The greater the ΔEN value, the greater the attraction of an electron pair to the atom of higher electronegativity. Although bonding is considered a continuum from pure covalent character ($\Delta EN = 0.0$) to increasing ionic character, certain ΔEN ranges correspond to the 3 general types of bonds. Polar covalent and ionic bonds are both considered polar bonds since both involve unequal electron distribution.

ΔEN	Type	Description
0.0 to 0.3	Covalent (non-polar)	Equal sharing of electrons
0.3 to 1.6	Polar Covalent (polar)	Unequal sharing of electrons
1.7 to 3.3	Ionic (very polar)	Transfer of electrons

For the N-H bond in ammonia, $\Delta EN = EN_N - EN_H = 3.0 - 2.1 = 0.9$. This bond is therefore classified as a polar covalent bond.

Further Reading: Refer to p. 252-254 of the textbook.

Bonding and Molecular Shape

1. Chemical Bonds are indicated below for some gaseous substances. Indicate which atom will be more positive and which will be more negative in each bond. If both atoms have equal positive or negative character, state that the bond is non-polar.

a) Na-Cl

c) P-O

e) C-C

b) C-F

d) K-H

f) $\begin{array}{c} \text{H} \quad \text{H} \\ | \quad | \\ \text{H}-\text{C}-\text{C}-\text{H} \\ | \quad | \\ \text{H} \quad \text{H} \end{array}$

2. Arrange the following in decreasing order of polarity:

F-F, C-F, H-F, C-H, Na-F

3. Identify the kind of bond contained in each of the following: HI, F₂, CsCl, MgO, O₂, KBr, AsH₃, PbI₃, PCl₃.

4. Classify the bonds in each of the following substances as covalent, polar covalent, or ionic:

a. K₂O

e. KCl

b. BeO

f. CBr₄

c. KH

g. N₂

d. SiF₄

5. Predict the shape of each of the following substances:

a. PH₃

d. PH₄⁺

b. H₂S

e. CF₄

c. SeF₆

6. Draw diagrams which show the 3-D molecular shape of:

a) CH₄

e) NF₃

i) BrF₅

m) BCl₃

b) Cl₂O

f) SiF₄

j) LiH

n) MgI₂

c) BeCl₂

g) SeF₆

k) H₂S

o) NH₄⁺

d) LiCl

h) PF₅

l) PH₃